# RESEARCH



# Instant messaging app use and depression among adolescents in South Korea: the roles of self-esteem and neuroticism

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# Doo-Hun Choi<sup>1\*</sup>

# Abstract

Analyzing two-wave panel survey data from adolescents in South Korea, this study examined how instant messaging app use is associated with depression. Specifically, this study tested a moderated mediation model to determine between instant messaging app use and depression through self-esteem, and whether this pathway differs according to one's level of neuroticism. The results showed that instant messaging app use was positively associated with self-esteem, which was negatively related to depression. Furthermore, the indirect association between instant messaging app use and depression through self-esteem was stronger as adolescents' neuroticism level increased. These findings advance our understanding of the effect of instant messaging app use on depression among adolescents. The current study has important implications regarding the role of instant messaging app use in adolescents' psychological health.

Keywords Instant messaging apps, Self-esteem, Neuroticism, Depression, Adolescents

# Introduction

Instant messaging apps, such as KakaoTalk, WhatsApp, and WeChat, are popular forms of communication among adolescents. As adolescents have a strong need to build friendships and maintain peer-group affiliations [1], instant messaging apps can fulfill this desire by providing convenient and cost-effective communication tools [1]. Since new media technologies influence adolescent communication and socialization [2], it is important to explore how these new communication channels may impact their mental or psychological health, such as depression.

\*Correspondence:

Doo-Hun Choi

choidoohun1@gmail.com

<sup>1</sup>Department of Media and Communication, Gachon University, 1342 Seongnam-daero, Sujeong-gu, Seongnam-si, South Korea Although previous studies have investigated the relationship between instant messaging app use and depression [e.g., 4, 5], few studies have explored the mechanism behind the effect of instant messaging app use on adolescents' depression. The present study attempts to understand the mechanism behind the relationship between instant messaging app use and depression by suggesting self-esteem as an important explanatory factor in their relationship. Instant messaging app use could influence self-esteem [e.g., 6], which is an important predictor of depression [7]. Thus, this study examines the connecting role of self-esteem in the association between instant messaging app use and depression among adolescents.

Depression is a common mental health problem among

adolescents and a major risk factor for self-harm [3].

Moreover, the study explores how the indirect relationship between instant messaging app use, self-esteem, and depression may differ depending on individual differences, such as personality traits. Personality traits



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represent relatively steady psychological characteristics over time that can affect one's mental health, attitudes, and behaviors in foreseeable ways [8]. The Big Five personality traits indicate five broad dimensions that describe individual differences in personality, including extraversion, openness, agreeableness, conscientiousness, and neuroticism [9]. Especially, neuroticism, one of the Big Five personality traits, is characterized by a stable propensity to experience negative emotional states such as nervousness, worry, or sadness [10]. As neuroticism indicates differences emotional stability among individuals [11], it is likely that the impact of instant messaging app use on depression via self-esteem may differ depending on a person's level of neuroticism. Thus, it is essential to explore the role of neuroticism as a moderator in the indirect association between instant messaging app use, self-esteem, and depression.

Figure 1 illustrates the proposed research model. This research model was tested by analyzed survey data collected from a two-wave panel among adolescents living in South Korea between 2017 and 2018.

# Theoretical background and hypotheses Instant messaging apps and depression

Instant messaging apps are online platforms that allow the exchange of various forms of messages, such as text, pictures, videos, and voice, on smartphones or digital devices among networked users [12]. Instant messaging apps not only provide synchronous interaction as realtime communication but also provide asynchronous interaction as time-lag communication between two or more people, regardless of time and space limitations [13]. Media richness theory [14] suggests that effective communication channels include (1) multiple cues such as non-verbal expressions, (2) instantaneous response, (3) personalization such as personal emotions, and (4) language variety such as language symbols [15]. Instant messaging apps demonstrate these four features of an effective communication channel. Particularly, instant messaging apps enable users to express emotions using emoticons, emojis or stickers, thus enlivening online communication and producing emotional support and exchanges [16]. Emoticons, emojis, and stickers in instant messaging apps help users express non-verbal cues, facial expressions, body movements, and voice tones. Nonverbal expressions function to sustain a conversation, assist in understanding (or strengthening) the intended meaning of verbal messages, and enhance enjoyment, which help maintain intimate relationships and affective interactions [17]. As instant messaging apps construct an intimate and personal communication environment for users, they can help strengthen social bonds and relationships among adolescents [13], which can affect their mental health conditions, such as depression.

Depression is a serious mental health problem that can cause constant and intense feelings of sadness or hopelessness and loss of interest in ordinary daily activities, such as school, home, and social relationships [18]. Severe depression may lead adolescents to attempt suicide or engage in suicidal behaviors [3]. Depression among adults often begins in adolescence [19]. Moreover, depression is largely associated with communication and media use [e.g., 20-22]. For example, insufficient communication and fewer social relationships among adolescents are major indicators of depression [23, 24]. Additionally, depressed individuals may tend to use more social media or instant messaging apps to seek social interaction or distract themselves from negative psychological states [25, 26]. Thus, it is vital for adolescents to develop and sustain communication and interpersonal



Fig. 1 Proposed research model

relationships for their mental health. Considering that instant messaging apps are designed to facilitate communication, develop social relationships, and exchange emotional support, adolescents' use of instant messaging apps may contribute to decreasing symptoms of depression. Therefore, the present study proposes a negative association between instant messaging app use and depression among adolescents. Therefore, the study posits the following hypothesis:

**H1** Instant messaging app use will be negatively associated with depression.

# Role of self-esteem between instant messaging app use and depression

How is the use of instant messaging apps associated with depression? This study suggests that instant messaging app use is positively associated with self-esteem, which may in turn be related to depression, demonstrating that self-esteem is a key mediator. The present study explores the potential connection both between instant messaging app and self-esteem and that between self-esteem and depression. Two theoretical frameworks explain the indirect association between instant messaging app use, self-esteem, and depression. First, based on the sociometer theory, this study proposes that instant messaging app use is positively associated with self-esteem. As the sociometer theory [27] explains, interpersonal relationships can significantly influence an individual's self-esteem [28]. This indicates that social interactions and relationships may help individuals improve their self-esteem. Instant messaging apps have been positively associated with increased social contact, which can promote self-esteem [29]. As self-esteem is largely obtained through socialization among adolescents [30], instant messaging app use may enhance their self-esteem. Second, based on the vulnerability model, this study suggests that self-esteem is negatively associated with depression. The vulnerability model explains that an individual's low self-esteem (or negative self-estimation) functions as a risk factor that can make individuals more vulnerable to developing depression [31, 32]. Indeed, a longitudinal cohort study conducted in the United States found that adolescents with high self-esteem had low levels of depression [33]. Thus, self-esteem is negatively associated with depression. Grounded in the sociometer theory and the vulnerability model, this study argues that selfesteem may contribute to the link between instant messaging app use and depression.

More specifically, self-esteem indicates the subjective evaluation of one's self-worth, representing a positive or negative attitude toward oneself [33, 34]. Self-esteem plays an important role in coping with stressful and challenging life events [35]. For example, individuals with

high self-esteem persisted longer in their tasks after failure than do those with low self-esteem [36]. By contrast, people with low self-esteem tend to express a more negative view of life and feel more rejected than those with high self-esteem [37]. Adolescence is a developmental period for the formation of self-identity and self-consciousness as an independent person [7, 38]. It is important for adolescents to have high self-esteem as they grow up. More importantly, self-esteem significantly impacts mental health, such as depression [35]. Previous studies have highlighted an association between self-esteem and depression, indicating that self-esteem is negatively associated with depression [e.g., 39, 40]. High self-esteem tends to make individuals maintain a positive view of themselves and decrease their opportunities to engage in negative thinking about themselves [36], which can reduce the risk of depression. In addition, high self-esteem plays a large role in facilitating positive interpersonal relationships and increasing the chances of obtaining social support [41], which can serve as a protective factor against depression.

Moreover, instant messaging app use can have an impact on self-esteem. Instant messaging apps allow users to engage in continuous and immediate communication [16], which can enhance their interpersonal interactions and social relationships. Instant messaging apps can further enable individuals to construct their online social networks, maintaining their connection with friends and family [42], which can foster a sense of belonging and social support. This social connectivity and acceptance derived from using instant messaging apps have the potential to enhance users' self-esteem. Therefore, instant messaging app use is likely to have a positive impact on self-esteem. Based on the above discussion, the current study proposes that self-esteem plays a connecting role in the relationship between instant messaging app use and depression. Therefore, we propose the following hypothesis:

**H2** Self-esteem will connect the association between instant messaging app use and depression.

#### Neuroticism as a moderator

Neuroticism refers to an individual's disposition to respond to negative emotions such as anxiety, sadness, or anger [43]. Neuroticism indicates low emotional stability, which means the inability to cope with negative emotionality [44]. Individuals with high levels of neuroticism tend to easily experience negative feelings or unpleasant mood states. By contrast, individuals with low levels of neuroticism tend to be less emotionally upset and are able to control their urges. Moreover, neuroticism is a significant risk factor for depression [45]. People with high neuroticism tend to have negative reactions to stressors and maladaptive emotion regulation strategies, which can contribute to the development of depression [10, 46]. Previous studies have empirically shown that neuroticism is positively related to depression [e.g., 47, 48]. Adolescents with high levels of neuroticism are also more likely to experience depression [e.g., 49]. Thus, it is important to identify adolescents with high levels of neuroticism to design preventive interventions that focuses on the beneficial effects of instant messaging app use on depression.

In addition to examining the association between instant messaging app use and depression through selfesteem, the present study also investigated the moderating role of neuroticism on these relationships. As neuroticism denotes individual variations in emotional stability, the influence of instant messaging app use on depression through self-esteem may differ according to one's level of neuroticism. Individual differences, such as personality traits, have been suggested to interact with the impact of media use on mental health [e.g., 50, 51]. Therefore, owing to individuals' different levels of neuroticism, their self-esteem obtained from instant messaging app use could produce varied levels of depression. As neurotic individuals tend to use digital media for social relations and communication [52], they are more likely to use instant messaging apps to establish online social networks and interactions than those with low levels of neuroticism, thereby improving self-esteem, which can be associated with low levels of depression. Because individuals with a higher level of neuroticism tend to be more sensitive to social feedback and experience emotional reactions to interpersonal interactions [53] when using instant messaging apps, their increased sensitivity to social cues and feedback may amplify the effect of online communication and interactions on their self-esteem. This enhanced self-esteem through instant messaging app use may have a stronger protective effect against depression for those who have high levels of neuroticism, as they may particularly benefit from social interaction on the messaging app [54], which may help mitigate emotional instability and insecurity. Neuroticism may strengthen the indirect relationship between instant messaging app use, self-esteem, and depression, thereby highlighting the critical role of individual differences in moderating the psychological impacts of digital media use. Thus, instant messaging apps could offer greater benefits to people with high neuroticism relative to those with low neuroticism by buffering the risk of depression.

In this regard, investigating the moderating role of neuroticism in the indirect relationship between instant messaging app use and depression through self-esteem will offer an understanding of individual differences in intensifying or decreasing the influence of instant messaging app use and self-esteem on depression. As a few studies have examined the moderated mediation association with depression, the current study could not address a directional hypothesis. Instead, the study suggests the following research question:

*RQ1:* How does neuroticism moderate the impact of instant messaging app use on depression through self-esteem?

# Method

# Data

The current study utilized data from the Korean Game Panel Study (KGPS), a panel survey of South Korean adolescents living in the Seoul Metropolitan Area. A government agency in South Korea, the Korea Creative Content Agency, manages the KGPS dataset to support the country's media industry such as broadcasting and games. Data were collected through face-to-face interviews of participants using a quota sampling approach based on the proportions of gender and school classes, such as elementary, middle, and high schools. Survey participants included 999 in 2017 (Time 1; hereafter T1) and 801 in 2018 (Time 2; hereafter T2), respectively. Therefore, the present study analyzed data from the final sample of 801 adolescents. The one-year interval between the two surveys ensured the robustness of our findings. First, the one-year interval can enable us to observe whether the effect of instant messaging apps use persisted over time. Second, it can help reduce the participants' fatigue and increase their engagement with surveys [55]. Third, previous studies have estimated the psychological or behavioral effects of digital media use by utilizing similar time intervals between surveys [e.g., 56-58]. Among the participants in the present study, 411 (51.3%) and 390 (48.7%) adolescents were female and male, respectively. Regarding school classes, 287 (35.8%), 295 (36.8%), and 219 (27.3%) participants were middle school students, high school students, and college students or collegeequivalent aged individuals, respectively. Participants were offered a reward for completing the survey. Since July 2019, the KGPS has provided public access to the dataset on their website.

#### Measurement

# Depression

*Depression* at T2 was measured using three items rated on a 4-point scale (1 = "rarely," 4 = "all the time"). This instrument was derived from the Center for Epidemiological Studies-Depression Scale (CES-D) designed by Radloff [59], which has been adopted from previous studies [e.g., 60, 61]. Participants were asked to rate how often they have felt the following way during the last week: "I felt depressed," "I felt sad," and "I felt that everything I did was an effort." An index of depression was determined from the average score of their responses to these three items (*Cronbach's*  $\alpha$  = 0.81, *M* = 1.40, *SD* = 0.56).

## Instant messaging app use

*Instant messaging app use* at T1 was measured using a single item rated on a 6-point scale (1 = "not at all," 6 = "very frequently"). This assessment item was developed by Jeong et al. [62], which has been applied to previous research [63]. Participants were asked to report their frequency of using instant messaging apps, such as Kakao-Talk, during the last 3 months (M = 4.49, SD = 1.46).

#### Self-esteem

*Self-esteem* at T2 was measured using two items rated on a 4-point scale (1 = "strongly disagree," 4 = "strongly agree"). The measurement item was constructed using the Rosenberg Self-Esteem Scale (RSES) created by Rosenberg [34], which has been used in prior studies [e.g., 35, 64]. Participants were asked to rate the extent to which they agree with the following statements: "I feel that I have a number of good qualities" and "I take a positive attitude toward myself." An index of self-esteem was determined from the average score of their responses on these two items (*Spearman-Brown Coefficient* = 0.78, M = 3.14, SD = 0.63).

# Neuroticism

*Neuroticism* at T1 was measured using three items rated on a 5-point scale item (1 = "strongly disagree," 5 = "strongly agree"). The survey question item came from the Mini-IPIP inventory developed by Donnellan et al. [65], which has been utilized in earlier studies [e.g., 66, 67]. Participants were asked to report the degree to which the agree to the following statements: "I get upset easily," "I have frequent mood swings," and "I seldom feel blue (reversed)." An index of neuroticism was determined from the average score of their responses on these three items (*Cronbach's*  $\alpha$  = 0.61, M = 2.50, SD = 0.78).

#### Analysis

The present study performed a moderated mediation analysis and a mediation analysis using the SPSS PRO-CESS macro to explore the research hypotheses and a research question [68]. First, for the moderated mediation analysis, this study employed PROCESS Model 14 to estimate the direct effect between instant messaging app use and depression (H1) as well as the indirect effect of how the impact of instant messaging app use on depression through self-esteem is contingent on neuroticism (RQ1). Second, for the mediation analysis, this study used PROCESS Model 4 to examine how self-esteem mediates the relationship between instant messaging app use and depression (H2). In addition, to control for factors that could possibly influence the associations among instant messaging app use, self-esteem, and neuroticism on depression, this study included school classes, gender, and depression at T1 (M = 1.37, SD = 0.57) as control variables in the analyses. Based on ordinary least squares regression, the PROCESS macro analysis allows us to test the direct and the indirect effects between variables simultaneously using a bootstrapping approach [68]. In particular, to assess indirect effects, this analysis used the 95% bias-corrected bootstrap method with 5,000 bootstrap samples, which can yield more accurate confidence intervals [68]. In the bootstrapping analysis, the indirect effects are considered statistically significant when the confidence intervals do not contain zero [68].

## Results

## Direct effects

Table 1 presents the findings of the relationships between instant messaging app use, self-esteem, neuroticism, and depression, including the unstandardized path coefficients and statistical significance. H1 suggested that instant messaging app use would be negatively associated with depression. However, instant messaging app use was not directly associated with depression. Thus, the result does not support H1. The finding showed that instant

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Table 1	Moderated	mediation	ettect of	instant	. messaging and	LISE SEIT-ESTEEM	neuroticism	and depression
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Classification		Mediating Model (DV: Self-Esteem)		Dependent Model (DV: Depression at T2)	
		Coefficients	SE	Coefficients	SE
Constant		0.335***	0.092	0.854***	0.072
Predictor	Instant Messaging App	0.036*	0.015	0.008	0.011
Mediator	Self-Esteem	-	-	-0.154***	0.027
Moderator	Neuroticism	-	-	0.118***	0.024
Interaction	Self-Esteem x Neuroticism	-	-	-0.114***	0.031
Covariates	Gender	-0.042	0.044	0.004	0.033
	Class	-0.053	0.028	-0.022	0.021
	Depression at T1	-0.272***	0.038	0.393***	0.033
Model Summary	R <sup>2</sup>	0.074		0.349	
,	F	15.856***		60.827***	

Note: Unstandardized regression coefficients and corresponding standard errors are reported. \* p <.05, \*\*\* p <.001

 Table 2
 Indirect effect of instant messaging app use on depression through self-esteem

Indirect Path	Estimate	SE	CI
Instant messaging app	-0.007	0.003	-0.013
use $\rightarrow$ Self-esteem $\rightarrow$			to
Depression			-0.001

*Note*: Unstandardized regression coefficients and corresponding standard errors are reported; CIs are bias-corrected 95% confidence intervals for the indirect effects (Bootstrap N=5,000)

Table 3 Index of moderated mediation

Moderator	Mediator	Index (SE)	CI
Neuroticism	Self-Esteem	-0.004 (0.002)	-0.009 to -0.003

 Table 4
 Conditional indirect effects of social media use

 on depression through loneliness moderated by levels of
 neuroticism

Moderator	Condition	Estimate	SE	CI
Neuroticism	Low	-0.002	0.002	-0.006 to 0.001
Neuroticism	Middle	-0.006	0.003	-0.011 to -0.001
Neuroticism	High	-0.009	0.004	-0.017 to -0.001

*Note*: Unstandardized regression coefficients and corresponding standard errors are reported; Conditions for moderator (neuroticism) are the mean (Middle) and one standard deviation below (Low) and above (High) from the mean. Cls are bias-corrected 95% confidence intervals for indirect effects (Bootstrap N=5,000)

messaging app use was positively related to self-esteem (B = 0.036, SE = 0.015, p < .05). In addition, self-esteem had a negative relationship with depression (B = -0.154, SE = 0.027, p < .001). Moreover, neuroticism was positively correlated with depression (B = 0.118, SE = 0.024, p < .001).

## Mediating effect

H2 posited that self-esteem would mediate the association between instant messaging app use and depression. As Table 2 presents, our analysis found the indirect path of instant messaging app use on depression through self-esteem (B = -0.007, SE = 0.003, 95% CI = -0.013 to -0.001). This indicates that instant messaging app use had a positive relationship with self-esteem, which in turn was negatively associated with depression. Thus, this finding supports H2..

#### Moderated mediating effect

The RQ1 asked how neuroticism moderates the effect of instant messaging app use on depression through self-esteem. As demonstrated in Table 3, neuroticism significantly moderated the mediating paths of instant messaging app use on depression through self-esteem (the index of moderated mediation = -0.004, SE = 0.002, 95% CI = -0.009 to -0.003). Furthermore, Table 4 presents the varying degrees of indirect effects according to the levels of neuroticism, showing that the indirect relationship between instant messaging app use and depression through self-esteem could differ depending on the level of neuroticism. The indirect effect of instant messaging app use on depression through self-esteem was significant for middle (B = -0.006, SE = 0.003, 95% CI = -0.011 to -0.001) and high (B = -0.009, SE = 0.004, 95% CI = -0.017 to -0.001). However, the indirect effect was not significant at a low level of neuroticism (B = -0.002, SE = 0.002, 95% CI = -0.006 to 0.001). These findings suggest that the indirect effect of instant messaging app use on depression through self-esteem becomes stronger as the level of neuroticism increases from middle to high.

# Discussion

The present study examined how instant messaging app use is related to depression through self-esteem and how the indirect association differs according to the level of neuroticism among adolescents in South Korea, analyzing two waves of panel survey data. The findings indicate that instant messaging app use had a positive relationship with self-esteem, which was negatively associated with depression. This pathway became more pronounced as the level of neuroticism increased. This study suggests that instant messaging app use among adolescents can benefit their mental health, considering it indirect relationship with low levels of depression through self-esteem.

Specifically, the current study demonstrated the crucial role of self-esteem in the association between instant messaging app use and depression. This result indicates that adolescents who used instant messaging apps more frequently were more likely to have higher self-esteem, which shows a low level of depression. As adolescents tend to use instant messaging apps to communicate with or make friends [69], instant messaging app use has the potential to improve their self-esteem by strengthening their social ties and sustaining their social connections, thereby producing positive mental health. Indeed, adolescents can gain the opportunity to learn and practice their social skills through online communication using instant messaging apps [70]. Instant messaging apps were found to be a major source of self-esteem in the present study.

Interestingly, the indirect route to depression was found to differ depending on adolescents' levels of neuroticism. This result suggests that individual differences can lead to varying effects of new media use on adolescents' mental health. The association between instant messaging app use and depression through self-esteem was stronger among adolescents with high neuroticism than those with low neuroticism. Particularly, compared to adolescents with a low level of neuroticism, those with a high level of neuroticism could obtain more benefits from using instant messaging apps, despite the positive effect of neuroticism on depression. More specifically, because adolescents with high neuroticism use instant messaging apps more frequently, they are more likely to benefit in terms of enhancing their self-esteem than those with low neuroticism, which is negatively related to depression. This result suggests that instant messaging apps might be a fruitful medium for enhancing self-esteem and contributing to reducing depression levels, especially among adolescents with a high level of neuroticism.

# Implications for practice and research

The present study has both research and practical implications. For research, this study makes significant contributions by advancing the theoretical understanding of and providing empirical evidence for established theories. Specifically, this study supported the notion of the sociometer theory and the vulnerability model. According to the sociometer theory, which posits that interpersonal relationships influence self-esteem, this study revealed that instant messaging apps, as a significant source of social connections among adolescents, positively impact self-esteem. Furthermore, consistent with the vulnerability model, which explains the negative association between self-esteem and depression, this study confirmed that self-esteem serves as a protective factor against depression. More importantly, this study showed the promise of connecting the sociometer theory and the vulnerability model through the bridging role of self-esteem to explain the mechanism by which instant messaging app use is associated with depression. In this regard, this study suggested a novel research model that describes how self-esteem mediates the association between instant messaging apps and depression. Another research contribution of this study is that its findings differ from those of previous studies on the impact of instant messaging apps on mental health. Inconsistent with the adverse effects of new media use on increasing depressive symptoms among adolescents [71], this study demonstrated the beneficial role of instant messaging apps in promoting adolescents' self-esteem, which negatively affects depression.

For practice, our findings have important implications for guiding adolescents and their parents and teachers. It is necessary to encourage adolescents to communicate and interact with their peers, friends, and family members using instant messaging apps to help enhance their self-esteem and promote their mental health. Moreover, it is essential for parents, teachers, and educators to be able to target particular segments of adolescents, especially those with a high level of neuroticism, to facilitate instant messaging app use so that they can benefit from the use of new communication technology.

#### Limitations and suggestions for future research

This study has some limitations. First, this study did not measure specific types of instant messaging app use. Adolescents may use instant messaging apps for diverse purposes such as games, news, or communication. Different uses could yield different outcomes regarding the association between instant messaging app use and depression. Therefore, future studies need to measure a more diverse usages of instant messaging apps to understand the influence of instant messaging app use on depression among adolescents.

Second, in the current study, a single item was used to measure instant messaging app use, which is not ideal. Single item measures are susceptible to measurement errors and reliability problems. However, considering that our measurement item was straightforward, participants could have found it easier to recall their media behavior retrospectively. To produce more robust results, future research should use multiple-item scales to capture the use of instant messaging apps.

Third, future research needs to examine the influence of digital conversations in instant messaging apps on adolescents' self-esteem. For example, some studies have argued for the detrimental effects of new media, such as cyberbullying, on adolescents' psychological well-being, including low self-esteem [72, 73]. The impact of instant messaging app use on self-esteem could differ depending on the nature of the conversations that adolescents engage in.

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#### Author contributions

Doo-Hun Choi formulated and completed the study.

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#### Data availability

The KGPS dataset of the present study is available upon request from the corresponding author. The KGPS dataset can also be downloaded on its website from the following link: https://www.kocca.kr/gameguide/subPage.d o?menuNo=203709.

#### Declarations

#### Ethics approval and consent to participate

This study used secondary data. Data were anonymized and contain no identifying information before release to the researcher. The dataset was publicly accessible to everyone. This study followed the guidelines of the Declaration of Helsinki. All participants in the dataset used in this study provided informed consent to participate.

#### **Consent for publication**

Not applicable.

#### **Competing interests**

The authors declare no competing interests.

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